PATENT SPECIFICATION (11) 1 589 052

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(21) Application No. 39505/76 (22) Filed 23 Sept. 1976
(23) Complete Specification filed 19 Sept. 1977
(44) Complete Specification published 7 May 1981
(51) INT. CL.³ B29C 17/04 //
B29D 23/00
(52) Index at acceptance
B5A 1R314C1C 1R314C1E 1R314C1F 1R429B 1R429X 2A3 2A4B 2A4C 2E1E 2E8 T10P

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(54) PIPE OF ORIENTED THERMOPLASTIC POLYMERIC MATERIAL AND METHOD OF FORMING THE SAME

(71) We, IMI YORKSHIRE IMPERIAL PLASTICS LIMITED (formerly YORKSHIRE IMPERIAL PLASTICS LIMITED), a British Company of PO Box 166, Leeds LS1 1RD, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The invention relates to a pipe of oriented thermoplastic polymeric material and also to a method of forming such a pipe.

In our UK Patent 1 432 539 we have taught a method of, and apparatus for, forming a pipe from orientable thermoplastic polymeric material by radially expanding a tubular blank into a mould at a temperature at which expansion of the pipe will cause orientation of the polymer molecules. In this manner the finished pipe has an oriented structure capable of with standing a greater hoop stress for a given wall thickness than a pipe made of the same material which has not been oriented, and has an enlarged oriented socket for carrying a sealing ring. In this manner a pipe was produced with an integral socket having a specified bursting strength with a smaller wall thickness than was previously possible, thereby reducing the volume of plastics used for a given pipe diameter and strength and minimising the cost of the materials required. Such pipes are typically manufactured from PVC, chlorinated PVC, high or low density polyethylene, polypropylene or ABS, although other suitable orientable polymers may be used. As the enlarged socket is of greater diameter than the remainder of the pipe, the wall of the socket is thinner than the pipe wall and consequently more flexible.

In practice we have found that, whilst the reduced rigidity of the socket is not critical, large diameter pipes subjected to high pressures can incur leaks past the socket seal due to the increased flexibility of the thinner socket wall.

According to one aspect of the invention a method of forming a pipe of oriented thermoplastic polymeric material having an integral socket of enlarged internal diameter includes placing a tubular blank having a portion of greater wall thickness in a female mould with the portion of greater wall thickness positioned within a portion of the female mould defining the integral socket, heating the tubular blank to a temperature at which deformation will induce orientation of the polymer molecules, applying internal fluid pressure to the tubular blank to force its walls radially outwards against the female mould whilst orienting the polymer molecules, the portion of greater wall thickness being forced into the portion of the female mould defining the socket, cooling the moulded pipe to a rigid condition, and then removing the applied internal fluid pressure. The tubular blank is preferably heated by means of a fluid, such as water, at a suitable temperature. The internal pressure is preferably applied by compressed gas or liquid under pressure. The method may also include forming the tubular blank with the portion of greater wall thickness by supporting a tube of constant thickness within a mould defining the portion of greater wall thickness, heating the tube to a moulding temperature, compressing the tube axially within the mould to form the portion of greater thickness, cooling the moulded blank and removing it from the mould.

According to another aspect of the invention a pipe of oriented thermoplastic polymeric material has an integral socket in which the cross-sectional area of material is greater than the cross-sectional area of material taken through another portion of the pipe. The wall thickness of the socket is preferably equal to, or greater than, the wall thickness of the pipe.

The invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a cross-section of a mould containing one form of tubular blank;

Figure 2 illustrates a modification of Figure 1;

Figure 3 is an enlarged scrap section of a socket at the end of a pipe produced in

ternal diameter as the outer diameter of the tubular blank 10, which is constant, and the thicker portion 19 is provided by locally decreasing the internal diameter. Whilst the blank 10 shown in Figure 2 could be manufactured as taught in UK Patent No 997 551, it could alternatively be manufactured by heating a tubular blank of constant wall thickness in a mould which defines the internal and external diameters of the thickened end portion 19, and by compressing the tubular blank 10 axially within that mould to define the thickened end portion 19 and by cooling and removing the blank from that mould. The tubular blank 10 illustrated in Figure 1 could conveniently be made in the same manner.

UK Patent No 997 552 teaches how a tubular blank with a thickened end portion can be formed into a non-oriented tube by expanding a core within the thickened portion to define an enlarged coupling socket. Although it has consequently been known for some time that a strengthened coupling socket can be formed at the end of a tube by expanding a tubular blank having a portion of greater wall thickness, it has not previously been proposed to use such a blank in the production of a pipe of oriented thermoplastic polymeric material manufactured, for instance, as taught in our UK Patent No. 1 432 539. The reason why we have not considered this possibility previously is that it was felt that the application of internal pressure to a tubular blank of non-constant wall thickness would cause the thinner portion of the tube to expand in preference to the thicker portion and that the operation would either be completely uncontrollable or it would not be possible to obtain a product which reflected the dimensional differences present in the blank. To the contrary, we have found that the process in our UK Patent No 1 432 539 will expand, in a satisfactory controllable fashion, a tubular blank having a portion of greater wall thickness, and that the result is an oriented pipe having an integral socket of greater rigidity than has hitherto been possible.

The mould used to produce the blank 10 of Figure 1 does not have to be split in the manner illustrated in the drawing. An alternative mould may be in the form of a tube with an end cap, giving a split at the socket groove.

WHAT WE CLAIM IS:

1. A method of forming a pipe of oriented thermoplastic polymeric material having an integral socket of enlarged internal diameter, including placing a tubular blank having a portion of greater wall thickness in a female mould with the portion of greater wall thickness positioned within a portion of the female mould defining the integral socket, heating the tubular blank to a temperature at which deformation will induce orientation of the polymer molecules, applying internal fluid pressure to the tubular blank to force its walls radially outwards against the female mould whilst orienting the polymer molecules, the portion of greater wall thickness being forced into the portion of the female mould defining the socket, cooling the moulded pipe to a rigid condition, and then removing the applied internal fluid pressure.

2. A method, according to Claim 1, in which the tubular blank is heated by means of a fluid at a suitable temperature.

3. A method, according to Claim 2, including circulating the heating fluid between the tubular blank and the female mould and draining the heating fluid away before the walls of the tubular blank are forced radially outwards against the female mould.

4. A method, according to Claim 2 or 3, including circulating the heating fluid through the bore of the tubular blank.

5. A method, according to Claim 4, including increasing the pressure of the heating fluid within the bore of the tubular blank to force the walls radially outwards.

6. A method, according to any of Claims 1 to 4, in which the internal fluid pressure is applied by compressed gas or liquid under pressure.

7. A method, according to any preceding claim, including forming the tubular blank with the portion of greater wall thickness by supporting a tube of constant thickness within a mould defining the portion of greater wall thickness, heating the tube to a moulding temperature, compressing the tube axially within the mould to form the portion of greater thickness, cooling the moulded blank, and removing it from the mould.

8. A method of forming a pipe of oriented thermoplastic polymeric material having an integral socket of enlarged internal diameter substantially as described herein with reference to Figure 1 of the accompanying drawings.

9. A method of forming a pipe of oriented thermoplastic polymeric material having an integral socket of enlarged internal diameter substantially as described herein with reference to Figure 2 of the accompanying drawings.

10. A pipe of oriented thermoplastic polymeric material having an integral socket of enlarged internal diameter produced by the method of any preceding claim.

11. A pipe of oriented thermoplastic polymeric material having an integral socket of enlarged internal diameter substantially as described herein and as shown in Figure 5 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed. 1981.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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Sheet 1

FIG. 1.

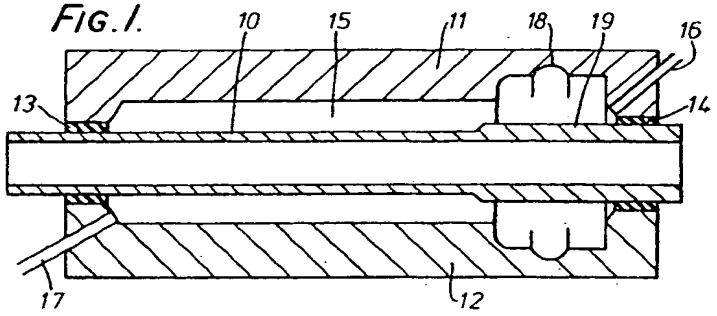


FIG. 2.

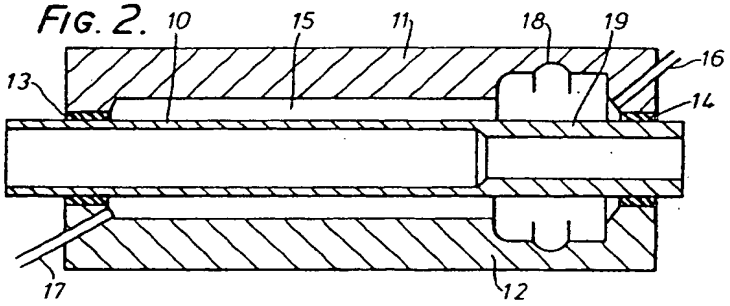
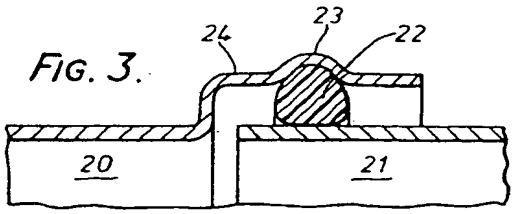


FIG. 3.



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Sheet 2

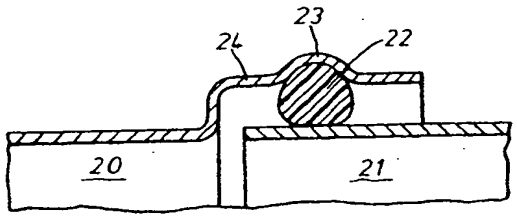

FIG. 4.

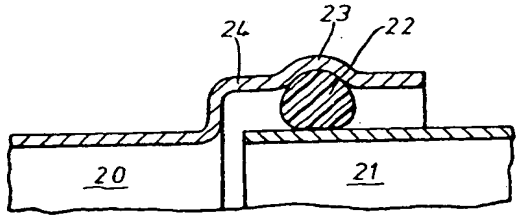

FIG. 5.